IN CLEAN COAL WE TRUST – OR DO WE?

Since 2011 and the nuclear catastrophe at Fukushima, Japan, the most significant energy revolution in recent history is now to be observed in Germany. The first economy of Europe has decided to totally abandon nuclear energy and aims at producing 35% of its electricity requirements by 2020 from 'renewable' sources. In the meantime, in order to compensate for the shortfall, another barely renewable energy source is coming on line again: coal. This is all the more surprising when we note German ecologists willing to accept and even support this environmental "crime", to ensure that nuclear generation will really come to an end. In doing do, Germany has now joined the club of major industrial counties whose economy relies largely on coal, where some other emblematic members are Poland (94% of their electricity comes from burning coal), South Africa (92%), China (77%) or Australia (76%).

Coal is the most polluting commonly used fossil fuel, both in terms of the so-called fine particles released into the atmosphere and of CO2 emissions. ADEME (The French Agency for Energy Control and the Environment) has measured the equivalent CO2 weight /tonne oil equivalent (TOE) for each energy source and came up with the following hit-parade: nuclear power generation (19 kg), wind turbines (32), photovoltaic solar (316), natural gas (651), petrol (830), diesel fuel (856) and coal (1123). Moreover, when coal is burned, it also releases a poisonous gas SH2 another well-documented greenhouse gas (GHG). Indeed coal is a very serious culprit when it comes to GHG emissions, the latter being – if we accept the conclusions of the majority of climate experts – the main causes for global warming and climate change.

But the days of coal are not yet over

Even if, ecologically speaking, coal is the worst energy source around, it nonetheless possesses some almost irresistible features. It is still abundant, easy and cheap to mine. Leaving out natural renewable energy sources, coal is the most abundant energy source and less concentrated, geographically, than oil. While some 60% of the reserves are located in just four countries (China, India and Russia and the USA) which, taken together amount to only 27% of the emerged land of the planet, with only 40% of the world's population today, there are deposits in practically every country, to a greater or lesser extent. Known reserves represent 150 years estimated needs and close on 200 years in certain counties, i.e., peak coal extends far further in time than is generally predicted for peak oil. Moreover, it is cheap. According to C2ES www.c2es.org/ (Center for Climate and Energy Solutions), 1 dollar spent on coal allows you to produce as much energy as you can get from 6 dollars spent on oil or natural gas.

Seen in this light, it is no wonder that numerous countries still use coal as their main energy source.

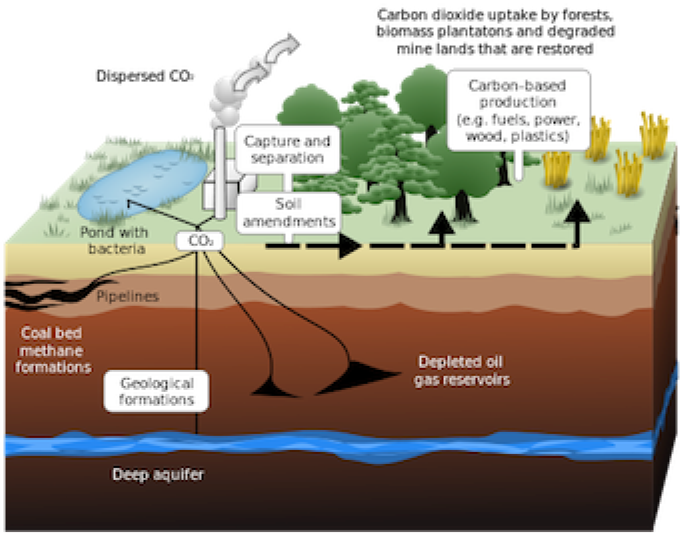
On average, coal accounts for 40% of the world's production of electricity, the percentage rising to 70% and to 80% in India and China, respectively. It will be noted, on one hand, that China consumes almost one half of all the coal burned in the world: 3.47 billion tonnes in 2011, according to the US Energy Information Administration (EIA), compared with 3.9 billion tonnes for the rest of the world. On the other, the consumption of coal in the OECD countries has been reduced, notably because of a strong upsurge of schist oil/gas extraction in the USA which in essence makes coal less competitive there.

The major trend points globally to an increase. World consumption of coal has increased by 5.4% in yr. 2011 and this indicates that coal is the fastest growing fossil fuel today. Outside the OECD, the increase has even reached 8.4%, mainly because of the strong Chinese upturn in demand. But the IEA (International Energy Agency) is formal: in yr.2017, global coal consumption will represent 4.32 billion tonnes oil equivalent, or TOEs, very close to the 4.4 billion TOE for oil and petroleum products themselves. Coal will therefore have almost caught up with oil, some 60 years after oil had moved ahead of coal.

This return of coal obviously leads to interrogations and concerns about environmental consequences, inasmuch as CO2 emissions will necessarily rise by proportions that no longer comply with international treaties on reduction of GHG emissions. Can emission be limited in some way? Research on the topic “clean coal” is not exactly enthusiastic. It is progressing slowly and stumbling regularly.

Ways and means to capture CO2

The way currently most explored is known as CCS (Carbon Capture and Storage). The process consists of capturing the CO2 produced at major emission sites (coal/gas/fuel burning power stations, factories, etc). This captured gas is then transported to repositories where it will be stored in deep-lying geological layers, with local temperature and pressure conditions such that the CO2 is stored in a liquid phase. The objective is to isolate the CO2 from the Earth’s atmosphere on a very long term basis.



Carbon sequestration – source Wikipedia

In December 2011, the European Commission's road-map called "Energies 2050" portended to plan the EU's energy transition in favour of renewable sources, underling the primordial role of CCS to attain carbon-free production of electricity and in industrial sectors by 2050 in Europe. Two priority challenges were highlighted in the road-map: economic viability and societal feasibility. These two targets, however, are turning out to be extremely 'touchy'.

Today several experimental programmes on artificial storage facilities and techniques are underway. Over 20 market-available CCS projects are being implemented round the world. Approximately 14 billion dollars have been earmarked for these projects. The oil company Total, in France, for example, after 3 years injecting in the Rousse pit (at Jurançon, Pyrenées-Orientales) some 50 000 tonnes of CO_2 from the French Lacq natural gas facilities ended the first pilot phase in March 2013. This is a project that has been operational since January 2010 and aims at testing a complete industrial scale chain of the Capture-Transport-Sequestration/storage process of CO_2. The following phase calls for monitoring of the environment and the storage repository for a three year period (2013-2016).

In contradistinction, Germany has now become ‘CCS-sceptical’ and the country has abandoned the only industrial scale project it had (at Jänschwalde); this illustrates clearly the crucial degree of uncertainty hanging over development of CCS techniques and sites, viz., the social and environmental (un)acceptability factor. The opposition to CCS focusses on the risks and impact of CO2 storage, especially at in-land sites. Outside the EU, the USA, Australia, Norway and Canada are very active in CCS developments. China is also joining in, showing a sharply increased interest in the field.

The main setback to development of CCS lies in the extremely high associate costs. The question is – how can we measure possible overheads here? Various specialists have tried to quantify the latter. The calculations lead to similar conclusions. For coal-burning power stations, the industrialists predict overheads at between 40-60 % of the price to produce 1 MWh – which covers amortisement of the initial CCS investments and operation-related costs. The price increase for installing CCS would lie between 500 Meuros and 1 bn. euros for a typical coal-burning station, generating over 250 MW. The overhead costs cannot be borne by the private investors alone, all the less so that the carbon market is not favourable. Other support incentives would be needed such as fixing a fixed price rate for carbon-free electricity, i.e., a floor price for the carbon (CO2).

Given that the European authorities in Brussels have not been convincing enough in this area, numerous industrialists have withdrawn their projects from the EU system. Their argument is straightforward and simple: the rapid drop for the price of carbon on the market-place (15€/tonne in 2010 to 6.5€/tonne in 2013). The European Commission now only foresees sales amounting to 1.3 to 1.5 bn. € for a first instalment of 200 M quota coupons, to be compared with the initially predicted 5 bn. €. The EC will therefore only be in a position to co-finance 2 or 3 CCS projects which is a long way removed from their earlier ambitions. The self-evident and sine qua non conclusion if we wish to see a valid CCS European project someday, is to engage in a major reform of the CO_2 emissions market.

Now, the embarrassing question – are we changing scale ?

On a global scale, geological sequestration would allow us to reduce (remove) 4 billion tonnes of CO_2 from the total world emissions by yr. 2050 (i.e., 10% of the annual commitments taken by world leaders), but the bill would be steep to say the least: 900 bn. US $ according to the IEA. The ecologists remain sceptical; as they see it, considerable funds are being side-tracked from research into renewable energy sources such as wind farm power generation or use of geothermal sites. Moreover, we would have to invest 25% more in 2015 for a coal-burning station just to install the CO_2 capture equipment. And this extra cost does not cover the cost of transporting the captured CO_2 to the repository storage sites.

An economic study published in July 2009 by the Centre International de recherche sur l'environnement et le développement (CIRED) shows that by using CCS technologies, the cost of production of energy (capital outlay and operational costs amounting to 7000 h/yr.) would be some 15-25 € higher, per MWh produced, than the cost at a standard non-equipped power station. This represents a unit price hike somewhere between 25 and 50%. Consequently, the cost of emission abatement lies between 25 and 45 €/tonne of avoided CO_2. Transportation and storage costs are probably going to gradually increase too, from 6 to 20 €/tonne, depending on the quantities of CO_2 already in storage.

In a more general manner, those hostile to pursuing use of fossil energy sources protest at any financing of a technology that could extend their exploitation. Greenpeace published, May 2008, a report on Carbon Capture and Storage entitled “False Hope” (Download document). Although they do not reject outright the principle of CO_2 capture, Greenpeace notes that neither the efficiency, nor the measurements of the CCS process can be demonstrably proven. Their stance is that by mid-21st Century, CO_2 emissions will amount to approx. 50 billion tonnes/yr. whereas the experiments conducted this far relate to quantities 4 orders of magnitude less!

Risk factors

CCS technologies present risks for the environment: CO_2 leakages from underground storage facilities, to soils, to water tables or to submarine trenches with consequent acidification of these milieus. Accidental leaks can prove fatal to local inhabitants, as was observed on the banks of Lake Nyos in the Cameroons, in 1986, when a huge ‘bubble’ of CO_2, released following a volcanic eruption led to the deaths of 1 700 persons and thousands of live-stock and wild animals within a radius off 25 km. Moreover, increased concentration of CO_2 in shallow levels of soils can also have lethal effects on plants and animals and can contaminate underground drinking water tables.

The storage (or sequestration) process must be under full control and such that in several centuries’ time, the stored CO_2 cannot return to the surface (and the atmosphere). In this respect CO_2 storage raised the spectre of dilemmas just as serious as those encountered for disposal of nuclear wastes in underground repositories. Carbon Capture and Storage (CCS) is as yet an immature technology and must still provide long-term guarantees as to the security of the reserves, viz., that the repositories are gas-proof. The Intergovernmental Panel on Climate Change (IPCC) members emphasise that “world scale (or regional or national) storage processes call for better assessment. We need to better understand the phenomena appertaining to confinement, seepage or long terms leaking. For the latter, monitoring and validation of CO_2 behaviour in deep geological layers must be improved”.

A study conducted in Switzerland by the Swiss Federal Office of Energy (SFOE) points to several risks: changes in local pressure conditions following CO_2 injections can increase seismic risks, as was indeed observed near Basel, end 2006-early 2007 after water was injected to procure deep geothermal energy; in the case of leakage, the CO_2 could seep from the deep-lying geological storage layers, forming acids that would dissolve heavy metals with an associate risk of polluting the water tables above. Important leaks from the CO_2 storage sites could alter surface biodiversity and modify the near-surface soil layers. Because of its density, the CO_2 could accumulate in surface hollows and, if there is a sufficiently high concentration of the gas, become a danger to local life, including human beings. Lastly, injection of CO_2 into salt water deposits underground could, under certain circumstances, free the brine that would then rise up through the geological layers to finally contaminate our drinking water tables.

In short, this readily observed strong return of coal and the somewhat damped enthusiasm in regard to CO_2 capture and sequestration lead on to framing a fundamental question: if we are to defend the case against global warming whilst waiting for a hypothetical situation where renewable energies would ‘win the day’, then what is the highest (un)acceptable risk – continuing nuclear energy supplies or increased atmospheric CO_2? Until such times as a satisfactory answer to this question is forthcoming, it would not be illogical for the CO_2 risk to be controlled by an international body, as efficient as the IAEA has been for nuclear energy issues. Moreover, it would be useful to see governments subscribing to and signing “CO_2 emission” treaties every bit as binding as the Treaty on the Non-Proliferation of Nuclear Weapons (1968).

Source : http://www.paristechreview.com/2013/10/15/clean-coal-trust/